



STEPPER MOTOR CONTROLLER / INDEXING CONTROLLER



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THIS MANUAL CONTAINS INFORMATION FOR INSTALLING AND OPERATING THE FOLLOWING PRODUCT:

- INDEXING CONTROLLER / STEPPER MOTOR CONTROLLER

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CONTENTS

Item	Page #
GENERAL DESCRIPTION	3
LOCATION OF COMPONENTS	4
TERMINALS	5
OPRATING THE INDEXING CONTROLLER	
1. MAIN MENU SCREEN	6
2. DIVISION MODE SCREEN	7
3. DEGREE MODE SCREEN	8
4. CONTINUOUS MODE SCREEN	9
5. JOG MODE SCREEN	10
6. CUT TO LENGTH SCREEN	11
7. PROGRAM RUN MODE SCREEN	12
8. PROGRAM EDIT MODE SCREEN	13
9. SETUP SCREEN	16
EXAMPLE PROGRAMS	18
CONNECTION DIAGRAM	19

GENERAL DESCRIPTION

Stepper Motor Controller (or indexing controller) is versatile single axis controller. This controller is intended to control rotary tables but can also be used to perform many custom operations. In circular motion (i.e. division or degree mode), there is no accumulation of error (i.e. the error is distributed in whole motion if the programmed motion cannot be achieved exactly due to odd gear ratio of other setting).

It can work either in simple indexing modes like dividing mode, degree mode and cut to length or fully programmable with I/O mode. In programmable mode, the “program” can be a maximum length of 170 instructions. As NESTED LOOPS are also supported, the actual program is capable of performing a variety of complex operations.

The following commands are supported: (see Program edit section for more details)

Motion setup: CCW, CW, SPEED, ACC, SETDIV

MOTION COMMANDS: MOVETODEG, MOVEBYDEG, MOVETODIV, MOVEBYDIV, MOVE TO MM, MOVE BY MM, MOVE TO CM, MOVE BY CM, CONT_START, CONT_STOP

CHECK INPUTS: WAIT_P, WAIT_S (WAIT FOR PULSE INPUT, WAIT FOR SENSE INPUT)

CHECK KEYPAD: WAIT_ANY_KEY

CHANGE OUTPUTS: OUTLOW x, OUTHIGH x

RECURSION: LOOPFOR, LOOPFOREVER, LOOPEND

DWELL: WAIT_SEC

SKIP PROGRAM: SKIP SENSE, SKIP END

COUNT CHECK: RUN COUNT++

OTHER: NOP, END, HOME, JOG

SPECIFICATION/FEATURES:

- **Supply Voltage:** 90V to 250V AC 50Hz/60Hz
- **Max Pulse Rate:** 40 KHz
- **Overall Size:** 165mm x 102mm x 76 mm
- **Mounting:** Panel mount: 155mmx92mm
- **Inputs:** 4 NPN Proxy (Pulse, Sense, Home and Emergency input)
- **Outputs:** 2 for motor (STEP and DIR) + Activity + Acknowledge + 4 General purpose + 12 V (for NPN proximity type sensor) + 5 V (for POT connections).
- **Display:** 20x4 LINES alphanumeric
- **Max Operating Temperature:** 55 deg C

LOCATION OF COMPONENTS: Major components of the Indexing Controller



The description of these components is as following:

1. NUMERIC KEYS (0-9)

Numeric keys are used for entering the numeric values in edit mode. In some modes, these serve alternate functions.

2. NAVIGATION KEYS PANEL (UP, DOWN, RIGHT, LEFT)

In edit mode, these keys are used to navigate the cursor. In some modes, these serve alternate functions.

3. OK & Esc

Press OK to enter in edit mode. In edit mode, pressing OK key saves the modified values in EEPROM. Press Esc to back out of menus/mode, Pressing Esc repeatedly returns the control to the main menu.

4. LCD DISPLAY (20x4)

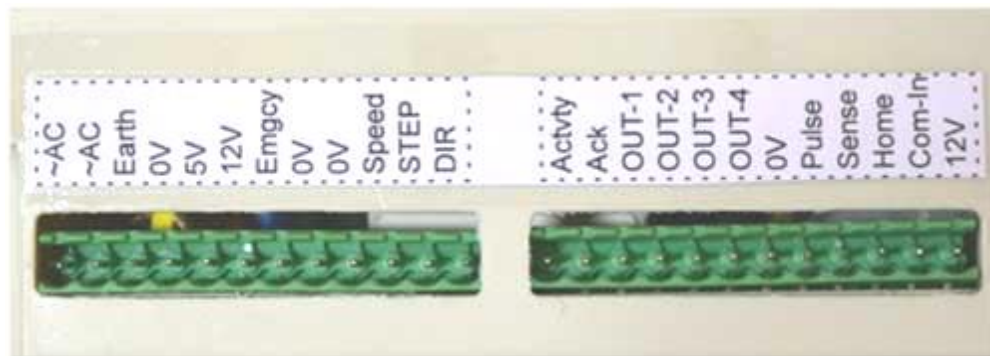
This LCD indicates all the information related to MENUS or MODES.

5. LEDs

RED LED indicates the activity and GREEN LED indicates long key press.

TERMINALS

REMOVABLE BLOCK TERMINALS:



PIN NUMBER

1. ~AC (90V to 260V AC 50Hz/60Hz Live, Handle with care)
2. ~AC (90V to 260V AC 50Hz/60Hz Neutral, Handle with care)
3. Earth (To Earth Main line, Handle with care)
4. 0V (Common ground, Connect to POT)
5. 5V OUTPUT (For POT connection)
6. 12V OUTPUT (For NPN type proximity sensors)
7. Emgcy- EMERGENCY INPUT (Connect output of N/O, NPN type proximity switch)
8. 0V (Common ground, For NPN type proximity)
9. 0V (Common ground, Connect to STEPPER DRIVER e.g. TSTEP-087)
10. Speed (Connect to center of POT for speed input in continuous mode)
11. STEP- STEP PULSE OUTPUT (Connect to STEPPER DRIVER eq. TSTEP-087)
12. DIR - DIRECTION OUTPUT (Connect to STEPPER DRIVER eq. TSTEP-087)
13. Actvty- ACTIVITY OUTPUT (Goes low while motor is moving)
14. Ack- ACKNOWLEDGE OUTPUT (Active low pulse after every move completion)
15. OUTPUT1 (General purpose output pin)
16. OUTPUT2 (General purpose output pin)
17. OUTPUT3 (General purpose output pin)
18. OUTPUT4 (General purpose output pin)
19. 0 V (Ground)
20. Pulse (Connect output of NO, NPN type proximity switch)
21. Sense (Connect output of NO, NPN type proximity switch)
22. Home (Connect output of NO, NPN type proximity switch)
23. Com-In (Common for above 3 inputs, can be supplied external 12 volt or jumped from 12v output from the controller)
24. 12V OUTPUT (For NPN type proximity)

OPERATING THE INDEXING CONTROLLER

MAIN MENU:



When the power is applied to the board, first a splash screen appears and then Home screen appears. All options are available on this screen. The user can return to home screen from any menu item by repeatedly pressing Esc key.

Press the number corresponding to the function you want to use.

1. Division Mode
2. Degree Mode
3. Continuous Mode
4. Jog Mode
5. Cut to Length Mode
6. Program Run Mode
7. Program Edit Mode
9. Setup Menu

NOTE: There is homing feature available on key 8. If user presses key 8 on home screen, motor moves in opposite direction to the direction set in setup menu and searches for home sensor input. In program edit mode, there is a “home” instruction for the same purpose.

NOTE: Anytime if Emergency input is received, motion is halted and current operation (even program run mode) is aborted. A message of emergency is displayed. Press any key to make the control return to HOME screen.

NOTE: HOME Screen can be bypassed by setting the “Boot” mode in Setup menu. This is useful if you want the controller to start in a particular mode. By setting boot mode to Program Run mode, the controller starts executing “Program” without any input from user.

1. Division Mode

When Division mode option is selected from MAIN MENU, the following screen appears.



This mode divides one revolution in predefined number of parts. For example, if the divide by is num 'x' then one complete revolution is completed by x number of key press or pulse inputs. Red LED glows when the motor runs.

Divide By: This parameter sets the value for dividing circle into number of parts in the range of 0002 to 9999. The required value of gear ratio, steps/rev, speed and acceleration and required direction can be set in the SETUP mode.

##: Change the speed after changing gear ratio and steps/rev in SETUP mode.

Status: Current division number is shown here. It cannot be set by the operator.

Key/Pulse: The Next Move (next division move for Division mode) can be initiated by giving pulse to the INPUT pin or pressing right navigation key. Use left navigation key to move the motor in opposite direction.

OK: Press "OK" key to enter in edit mode. This allows the user to change the parameters on this screen.

Esc: Press Esc to exit from current menu to main menu.

##: Speed is dependent on gear ratio and steps/rev. There is no accumulation of error in Division when the resultant motor steps are a fractional number. The error is compensated/spread over the entire revolution so that after x number of moves, the table reaches exactly the same position where it started (if direction is not changed).

2. Degree Mode

When DEGREE mode option is selected from the MAIN MENU, the following screen appears.



This mode is used whenever a movement is required in degrees. On each pulse (or key press), motor moves by set degrees. Red LED glows when the motor runs the set degrees.

For example, if the set value for move degree is 090.0, then on each pulse it moves 90 degrees. And one revolution i.e. 360 degree is completed in 4 key or pulse input.

MoveDeg: This parameter sets value to move in degrees, it can be set from 0.1 degree to 999.9 degrees. The required value of gear ratio, steps/rev, speed and acceleration and required direction can be set in SETUP mode. In order to refer to the SETUP mode, press 9 after exiting from degree mode menu.

##: Change the speed after changing gear ratio and steps/rev in SETUP mode.

Status: Current degree is shown here. It cannot be set by operator.

Key/Pulse: The Next Move (next degree move for Degree mode) can be initiated by giving pulse to the INPUT pin or pressing right navigation key. Use left navigation key to move the motor in opposite direction.

OK: Press "OK" key to enter in edit mode. This allows the user to change the parameters on this screen.

Esc: Press Esc to exit from current menu to main menu.

##: Speed is dependent on the gear ratio and steps/rev and it changes in accordance to these values set in Setup menu. There is no accumulation of error in Degree mode whenever the resultant motor steps are a fractional number.

3. Continuous Mode



Speed-RPM Dir Action
0990 CW MODE_0
INPUT:Pulse/Sense
Ok:Edit Esc:Exit

When CONTINUOUS mode option is selected from the MAIN MENU, adjacent screen appears and shows set value of Speed in RPM/ RPH, Direction and Action. On each pulse input or key press, the motor starts or stops. Red LED glows when the motor runs.

Speed: This parameter sets velocity that the motor achieves. The range of velocity is from 1 to 1200 (its max value depends on Gear ratio and the steps/rev).

If Speed_POT input is enabled in Setup menu, speed parameter is set from analog input and cannot be edited using keys. We can set speed manually as well as by the POT attached. However gear ratio and steps/rev affect speed in both cases.

Dir: This parameter set direction CW (clockwise) and CCW (counterclockwise). This parameter set in continuous mode doesn't affect the direction set in Setup mode. However, if direction is changed in Setup mode then direction in continuous mode also changes.

Input: It shows the movement when an input is received at pulse pin or sense pin on the basis of mode set in Action parameter. Use up navigation key for next mode and down navigation key for previous mode. Red LED glows at the time of activity and green LED glows when any key is pressed long.

Action: This parameter is used for setting Action. Action has 7 modes. These modes are described below one by one:

Mode_0: When a pulse is given at pulse input pin, the motor rotates in the direction set and stops on receiving the pulse on sense input pin.

Mode_1: In mode_1, motor rotates in direction set as far as the input signal is received at pulse input pin. And motor rotates in opposite direction if the signal is received at the sense input pin. However if the input signal is applied to both the input pin, then no activity takes place.

Mode_2: In mode_2, as far as the input signal is received at pulse input, the motor continues to rotate in direction set. However, if an input signal is received at pulse input pin and also on sense input pin, motor begins to rotate in opposite direction.

Mode_3: In mode_3, when a pulse is received at input pin, motor begins to run in direction set. However, motor rotates in opposite direction as far as the input signal is applied to sense input. The motor stops when the input pulse is received on pulse input pin.

Mode_4: In mode_4, when an input pulse is received at pulse input pin, motor begins to rotate in direction set and stops when pulse is applied at the same pin.

If the motor is rotating on applying the pulse at pulse input pin and meanwhile an input pulse is applied at sense input pin, the motor starts rotating in opposite direction.

However, when an input pulse is received at sense input pin, motor starts rotating in opposite direction and stops when the pulse is applied on the same pin.

Mode_5: In mode_5, when the right navigation key is pressed, motor rotates in direction set until the key is pressed. And when left navigation key is pressed, motor rotates in opposite direction until the key is pressed. Green LED glows on long pressing the keys.

Mode_6: In mode_6, motor rotates in direction set when the right navigation key is pressed. However, motor rotates in opposite direction when the left navigation key is pressed. The motor stops when either right or left navigation key is pressed.

OK: Press “OK” key to enter in edit mode. This allows the user to change the parameters on this screen.

Esc: Press Esc to exit from current menu to main menu.

If user wants to use pot for speed control then enable the Speed_POT in setup menu.

4. Jog Mode

When JOG mode option is selected from the MAIN MENU, the following screen appears.



JOG mode is used to position the table before entering in any mode. This function can also be called in between program instructions, in programming mode.

Red and Green LED glows when the motor jogs.

Cont.jog:

Table moves continuously with Cont.speed until the time key is pressed. This is handled by left/right navigation keys.

Cont.speed:

Jog speed can be changed by two ways:

1. If Speed_POT is set disabled in Setup menu, press up-down navigation keys to set the speed of continuous movement. Range of Cont.speed is from 1-99. Up key increases jog speed and down key decreases jog speed.
2. If Speed_POT has been enabled, change the Cont.speed by POT. Up-down navigation keys don't work in this condition.

[1], [6]: Move the table CCW/CW by 0.1 degree for each press.

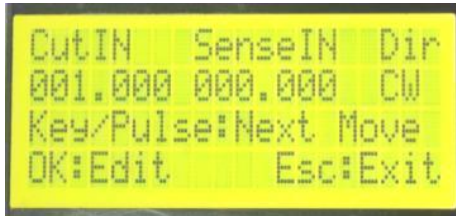
[2], [7]: Move the table CCW/CW by 1 degree for each press.

[3], [8]: Move the table CCW/CW by 10 degree for each press.

Note: Cont.speed is irrelevant of gear ratio, Speed, acceleration and Steps/Rev.

Esc: Return from current mode to the MAIN MENU. If this command was called when a program is running, pressing Esc key returns and resumes program where it was left.

5. Cut to Length Mode



When Cut to Length mode option is selected from MAIN MENU, adjacent screen appears and shows the set value for CutIN, SenseIN and Dir. This mode is used whenever it is required to cut a particular length of material. Red LED glows when motor runs.

User can cut material in the units of mm as well as inches. Move to Unit parameter using left-right navigation keys and select MM using up-down navigation keys. If motion of motor is required in mm and then set values for Cut, sense and direction parameters.

For example in bag making machine, mark is available to cut sheet but sometimes distance between marks are not equal. Say if mark to mark length is 100mm, then it may differ in the range of 97mm to 103mm. In this case, we put distance of CutMM with 97mm and remaining 6mm is filled in SenseMM, and CutMM value is always less than mark length. When input signal activates, it moves till CutMM and after that SenseMM signal activates. In this process, it is expected that mark sensor should activate in the span of 97mm to 103mm. If it activates between 97mm to 103mm, motor stops and cut is executed. And if sensor fails to activate in the span of 97mm to 103mm for any reason, motor stops at 103mm, and cut is executed. But this is not proper cut. If it happens three times consecutively, mark error is declared. Press key 1 in Cut to length mode to see the mark error number. After three consecutive mark errors, a message appears. Press any key to exit from this error screen.

However, if user wants to reset the mark error number in between the cut to length execution, the user has to give a pulse on Sense input while the motor is running.

CutMM/ IN: CutMM/ IN is input length which is always less than mark length. It ranges from 1 to 9999. MM represents motion in mm and IN represents motion in inches.

SenseMM/ IN: SenseMM/ IN is the sensing zone length in mm for mark sensor. The mark sensor is sensed in this range.

Dir: This parameter is used to set direction n CW (clockwise) and CCW (counter clockwise).

Key/Pulse: The Next Move can be initiated by giving pulse to the INPUT pin or pressing any navigation key.

OK: Press “OK” key to enter in edit mode to change the parameters on this screen.

Esc: Press Esc to exit from current menu to main menu.

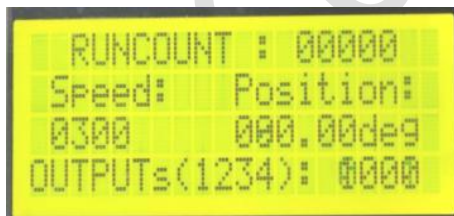
In this mode, if value of sense mm is 0, then the sense input is ignored and controller works in Move by MM mode, else it scans sense pin and works in Cut to Length mode.

6. Program Run Mode



Press key 6 to enter in program run menu from main menu. A provision for four programs is provided in Stepper motor controller. The program can be a maximum length of 170 instructions and can be edited in program edit mode. Use key 1-4 to select the required program. Press Esc key to exit from program run menu.

If there is no program loaded in flash, a message “INVALID PROGRAM” appears. Enter in set up mode and select yes for factory reset. It loads four default programs in flash.



After the user selects a program, the adjacent screen appears. It shows current position and speed of motion for program selected. Whenever controller waits for any input, it is displayed by a wait message. At time activity takes place, red LED

glows. OUTPUTs (1234) show the state of output pins 1234. “1” shows the high state at the output pin whereas “0” shows the low state at the pin. (See the terminals section for output pins 1-4).

Run count shows how many times a program or a section of program has been completed. If a user has inserted the run count command in the program, then only the increment in run count is shown else run count remains 00000.



The adjacent message appears along with run count when the complete program is executed. Press Esc key to exit to main menu. All the commands that can be used in programs are discussed in Program edit menu.

7. Program Edit

LIST OF COMMANDS

CCW

When this command is set, the motion takes place in anticlockwise] direc[tion.

CW

When this command is set, the motion takes place in clockwise direction.

HOME

This command is used for home purpose. Before using this command, direction must be set.

JOG

This command is used for initial setting of table position using jog mode.

NOP

This command is used for no operation. It can be used to temporarily remove an instruction by replacing it with a NOP.

END

This command is used to end program and every program must have END command at very last.

WAIT_PULSE

When this command is used, then next command takes place after Pulse input is received.

WAIT_SENSE

When this command is used, then next command takes place after Sense input is received.

WAIT_ANY_KEY

When this command is used, next command takes place after ANY_KEY is pressed.

OUTLOW (value)

This command is used to set the OUTPUT “x” to low (x is 1 to 4).
(The OUTPUT pin will be at low level or 0V).

OUTHIGH (value)

This command is used to set the OUTPUT “x” to high (x is 1 to 4).
(The OUTPUT pin will be at high level or 5V.)

CONT_START

This command is used for continuous motion at set SPEED, Pot input is ignored, and the motor Accelerates at set Acc. Value.

CONT_STOP

This command is used to stop continuous motion; motor decelerates to stop at current Acceleration value.

LOOPFOREVER

This command is used for infinite loop.

SPEED (value) range is 0001 to 1200 (RPM/ RPH)

This command is used to set the maximum speed, which motor achieves while in operation.

ACCEL (value) range is 01 to 20

This command is used to set acceleration.

MOVETOMM (value) range is 00.00 to 99.99

This command is used when movement is required in absolute distance in mm.

MOVEBYMM (value) range is 00.00 to 99.99

This command is used when movement is required in relative distance in mm.

MOVETOCM (value) range is 00.00 to 99.99

This command is used when movement is required in absolute distance in cm.

MOVEBYCM (value) range is 00.00 to 99.99

This command is used when movement is required in relative distance in cm.

MOVETODEG (value) range is 000.0 to 999.9

This command is used when movement is required in absolute degree.

MOVEBYDEG (value) range is 000.0 to 999.9

This command is used when movement is required in relative degree.

SETDIV (value) range is 0001 to 9999

This command is used to set division.

MOVETODIV (value) range is 0001 to 9999

This command is used when movement is required in absolute division.

MOVEBYDIV (value) range is 0001 to 9999

This command is used when movement is required in relative division.

WAIT_SEC (value) range is 000.1 to 999.9

This command is used to generate delay between two commands.

Setting WAIT_SEC = 1 gives the delay of 1 second.

LOOPFOR (value) range is 0001 to 9999

This command is used for looping and must be ended with LOOPEND.

LOOPEND

This command is used to end loop instruction and every loop (LOOPFOR or LOOPFOREVER) must be ended with LOOPEND.

SKIPSENSE

This command is used to skip a segment of instructions in program.

When sense input pin is set low, SKIPSENSE = 0 executes and SKIPSENSE = 1 is skipped.

When sense input pin is set high, SKIPSENSE = 1 executes and SKIPSENSE = 0 is skipped.

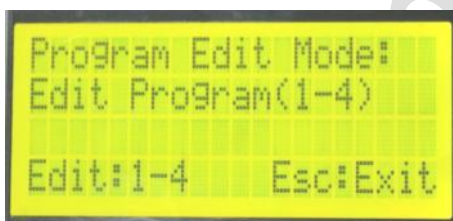
SKIPEND

This command is used to determine the length of program segment until where the SKIPSENSE is to be executed.

RUNCOUNT++

This command is used to determine how many times a program/ or a section of programs has been executed. Run count gets reset when controller enters in program edit mode.

Editing the Program



1. Enter in program edit menu, as shown in the adjacent screen to edit the existing program .

2. Select any program from the four programs by pressing respective numeric key and enter.

3. The screen (adjacent) shows a window of 3 lines of program along with a cursor (>).

4. Lines begin with the current line number followed by the command and its value.

The cursor shows current line while next to the cursor, current line number is displayed. In above figure, cursor is currently on line number 1. Command/instruction can be changed by pressing left-right navigation keys and values can be entered by number keys [0]-[9]. Use up-down navigation keys to change the line. Press Ok key to modify

program after making all changes. Press Esc key to discard the modifications made and retain to previous settings on exiting from program edit menu.

9. Setup Menu



When setup option is selected from MAIN MENU, the adjacent screen appears. A provision for two profiles is given in Stepper motor controller in which the user can save two different setup menus. User needs to input the profile number in setup menu when it is required to be used.

Use navigation keys and numeric keys to change menu settings. Save the modifications by pressing OK key or discard by Esc key.

Gear ratio: This parameter sets gearing ratio. The range for gear ratio is (001.0 to 999.9).

Step/rev: This parameter sets Steps (or pulses) required for a single revolution of motor shaft. Range for step/rev is (200 to 9999).

Step/MM: This parameter sets Steps (or pulses) required for 1MM of linear motion. Range for step/rev is (0000.01 to 9999.99).

Pulse width: This parameter sets width of step pulse driven to the motor. The range for step pulse width is $2\mu\text{s}$ to $8\mu\text{s}$. It can be changed by the left-right navigation keys, not by numeric keys.

Direction: This parameter sets direction (CW-clockwise and CCW-anticlockwise) for all modes except the continuous mode. However, direction can be changed using left-right navigation keys after entering in modes.

Speed_POT: This parameter enables or disables the use of pot in continuous mode. By default, pot is set disabled.

Accel: This parameter sets Acceleration. Range for acceleration is (01 to 20).

Speed: This parameter sets Max Speed (in RPM/ RPH). It is the maximum speed motor achieves. And the range for Max Speed is (1 to 1200).

Backlash: Backlash is any non-movement that occurs during axis reversals. For example, if X- axis is commanded to move 1 cm in a direction, and immediately after it

is commanded to move 1 cm in the reverse direction. If the backlash exists, then it does not immediately start reverse movement and motion departure is not precisely 1 cm.

“Backlash compensation/ backlash” feature simply allows the user to add the additional amount of backlash in same units for axis reversal. For example, for move by degree, backlash compensation is in degrees and for move by mm, backlash compensation is in mm.

Home Speed: This parameter sets Max Home Speed (this is the maximum speed motor achieves while home). And the range for Max Home Speed is 1 to 1200.

Home Input: This decides whether the home search input is to be low or high.

Boot Mode: This parameter sets the Boot up mode for the controller. It can be set to any mode (listed in the MAIN MENU). For example if it is set to “PgmRun” mode, the controller bypasses the Main Menu screen and directly starts in RUN mode.

NOTE: In cases where the boot mode is set to Program mode and the program has some infinite loop (or some error), the boot mode can be reset to default ‘home’ screen. To reset, switch off the controller and hold ‘0’ Zero key while switching on the controller.

Default Program: Default program sets which program is to be run after booting, if boot mode selected in ‘program run mode’.

Splash Screen: This parameter turns Off/On initial splash screen. One use of making splash screen off can be fast boot up time.

Homing on Boot: This parameter if set yes, enables homing after booting.

Factory Reset: This parameter reset all parameters to Factory Defaults. It can be used if you want to start over, and it also loads a SAMPLE program erasing any user program stored at EEPROM memory.

Homing



Homing feature is available on key 8. If users press key 8, motor moves in opposite direction to the direction set in setup menu and searches for home sensor input. In program mode, there is a “home” instruction for the same purpose.

The above message appears when key 8 is pressed. See connection diagram for home switch connection.

Example program

Example program 1:

To move a disk 36° with speed 400 RPM, acceleration 1 at every pulse input, endlessly.

Assuming TSTEP-087 stepper driver (which is “10 micro-step” drive), takes 2000 pulses for one revolution. Also rotating disk is directly mounted on the motor shaft so gear ratio is 1. Set these parameters in SETUP menu, by pressing the key 9 from home menu, Set gear ratio as 1 and Steps/Rev revolution is 2000. Save changes and exit to home screen by pressing ‘ok’.

Now go to “Program Edit Mode” to edit the instructions for the Program.

```
ACCEL          1
SPEED          0400
DIR CW
LOOPFOREVER
WAIT_PULSE
MOVEBYDEG      036.0
LOOPEND
END
```

Save the Program and exit to home screen by pressing “Ok” key.

The program can be run from main menu selecting “Program Run Mode”.

Note: In setup menu, the boot mode can change to “Program Run Mode” so program is executed from next time every time the controller is switched on.

Connection diagram

